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"Electrical Bomber"

By MORRIS ROBISON, AERO. E. III

Prior to the advent of the B-29 Superfortress, America's greatest air weapon lay in her heavy bombers, notably the B-17 and the B-24. Much has been said about the effectiveness of these planes, of their great bomb loads and extreme accuracy in destroying the enemy's productive areas, but little has been told of the planes intricate workings, the means by which the planes become efficient forces of destruction.

Taking the leading role after the engines and fuselage, is the part that electricity and electrical equipment plays in sustaining flight. A description of the major parts will convince the reader of the importance of this equipment.

The entire aircraft embodies a complete electrical entity, a system for generating current, storing it and converting it to power, heat, and light. This entity provides a convenient means by which we can subdivide and describe the system.

The generating system consists of four 200 amp., 30 volts d.-c. generators, one attached to and driven by, each engine. Voltage regulators located in the bomb bay keep the voltage at 28.5. These generators naturally do not supply any power while the engines are not running, so that some current source must be available for starting the engines. This current is supplied by three 24-volt storage batteries which are kept charged by the generating system. They are not for constant use as their capacity is rather small. Alternative to using the ships batteries, a small gas driven power supply is located in the rear of the ship. The one-cylinder engine drives a 75 amp. generator, the output of which is sufficient to energize the engine starter. By starting this small unit by hand, the aircraft engine can be started without depleting the storage battery reserves. After the first engine is running, the output of its generators is more than sufficient to supply the other starting current needs, engines two, three, and four.

Little more can be said about the current storage system. It is in effect the three storage batteries mentioned. They are not much good for continuous service, but indeed there is little use for a current supply if none of the engines is running in flight.

Of the three current consuming categories in an aircraft, heat and light are probably the two less important. Not that we could consider a bomber without heat and light, but the current

demand is far less than that asked for by the power units of the ship. Of these two, the heat demands the least amount of current—current to heat the flying suits of the flyers and crew.

The lighting system is chiefly that of the external lights, landing and passing lights, recognition lights, running lights, and bombing lights. Important internal lighting is that supplied for the instrument panel, the navigator's desk and the radioman.

Mention has been made of the "power units" in an aircraft without explanation of what they are or what distinguishes them from the other

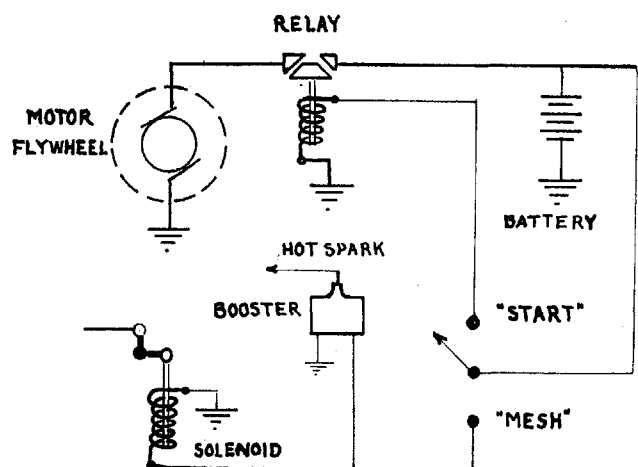


FIG. 1
STARTING CIRCUIT MR

current consumers. I feel it would be justifiable to put into this category all units which in some way consume current to do work. I think it would interest the reader to know how these units work as well as what they are for. In nearly all of these units an electric motor of some type supplies the energy but it would be well to see the various methods of using the energy.

The engine starter previously mentioned is initially a high current consumer. It consists of a small electric motor directly attached to a heavy five-inch flywheel. Prior to starting, this motor and flywheel are energized until they revolve at about 12,000 RPM. When they reach this speed, they are coupled to the engine through a compound planetary gear system which delivers the high torque, slow RPM required for starting the engine. It is the kinetic energy of the revolv-

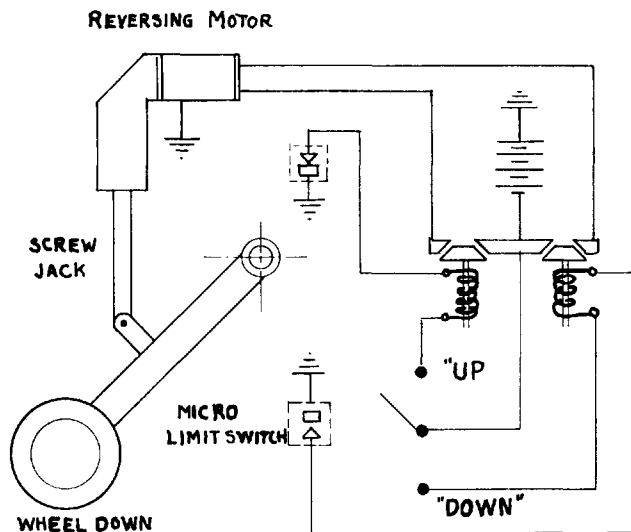


FIG. 2
RETRACTION SYSTEM MR

ing flywheel and motor which supply the starting torque. A rather simple circuit (Fig. 1.) shows how the motor is energized and the engine started. In starting the engine the pilot holds the toggle switch in the "Start" or up position for about 10 to 20 seconds until the flywheel is up to speed. Then he throws the toggle down to the "mesh" position. This closes the solenoid mesh circuit which engages the gear system to the still engine. At low starting speeds the magneto is inoperative so that an extra hot delayed spark is supplied by the booster circuit in parallel with the mesh circuit. When the engine begins to fire, the magnetos supply the spark and the pilot releases the toggle disengaging the mesh system and opening the booster circuit.

The retractable landing gear is quite frequently operated by electrically driven screw jacks. There are usually other alternatives, hand operated or hydraulic lift devices. In this type of device, use is made of remotely placed relays which eliminate the necessity of running high current leads to the cabin. The pilot's wheel switch closes the relay energizing the motor jack, and when the wheel retracts into the fully locked position, a micro limit switch automatically breaks the circuit preventing damage which would result from overtravelling screw jack. A typical circuit is shown in Fig. 2.

Very similar circuits and methods are used to operate the wing flaps used in takeoff and landings, and to open and close bomb bay doors.

On a B-17, control of the propellor pitch is achieved by a hydraulic servo unit deriving its pressure from gear type oil pumps in each engine. During flight the change in pitch is automatically

controlled by the engine itself but in combat this control is lost if an engine is shot out by anti-aircraft batteries. It is vital that the pilot is able to bring the propellor into "full feathered" position—edges turned directly into the wind—so that the "windmill" effect does not cause the plane to lose altitude or in severe cases shake the engine from its mount. To accomplish this feathering an auxillary oil pump mounted in the nacelle and driven by an electric motor supplies oil at 400 p.s.i. to the servo unit bringing the prop blades into the wind. Similar to this oil pressure pumps are many pumps throughout the ship, much lighter in construction. They consist chiefly of gasoline booster pumps, transfer pumps to redistribute fuel when unbalancing occurs, anti-icer and de-icer pumps.

It might be interesting to distinguish for the reader the difference between the anti-icer and the de-icer system. Anti-icer is the device which prevents the formation of ice on the leading edges of the propellor. It is rather simple but unique. Briefly a small electric pump controlled by a rheostat pumps a mixture of alcohol and glycerine to a slinger ring located at the center of each propellor. Small outlets at the root of each blade permits the liquid to flow down the length of the blade while it is rotating and effectively produce a typical anti-freezing mixture. On the other hand, a de-icer system is one which removes ice, after formation, from the leading edges of the

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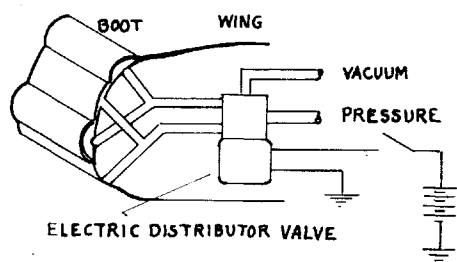
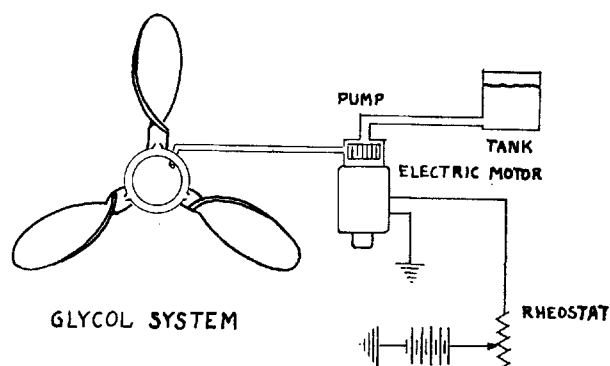


FIG 3
ANTI-ICER AND DE-ICER SYSTEM MR

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airfoils, wings horizontal and vertical stabilizer. Wing icing, strangely enough, does not necessarily occur only when the air temperature is below freezing. It is known that icing can form at temperatures near 50 degrees F. due to a phenomenon known as supercooling. This takes place when the moisture particle strikes the surface of the fast moving ship. To combat this condition, which gives the ship poor flying characteristics and overloads it, an intricate air pressure and vacuum system of de-icer boots has been developed. It is in the control and operation of these boots that electrical distributor valves play their role. (Fig. 3.)

To defend the ship, gunners must be able to rely upon the smooth, certain operation of their turrets. There are many types of turrets in operation today. One of them is the type which receives electrical power from the craft and uses

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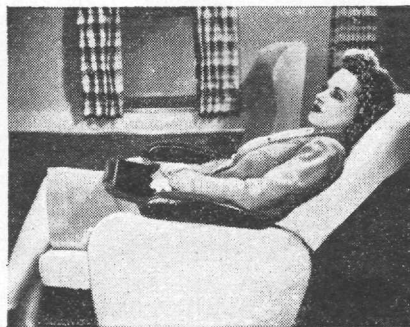
New York North Africa		
	FLIGHT 203	ELAPSED TIME
NEW YORK	LV. 9:44	
WASHINGTON	LV. 11:35	
MIAMI	LV. 5:50	
SAN JUAN, P. R.	LV. 12:45	7 HRS
GEORGETOWN	LV. 9:10	27 1/2 HR
BELEM	AR. 5:15	35 H
BELEM	LV. 2:00	44 1/2 HR
NATAL	LV. 2:25	69
ASCENSION	LV. 1:30	
ACCRA	LV. 11:55	
MAIDUGURI	LV. 6:00	
KARTOUM	LV. 1:00	

Where do you want to go?

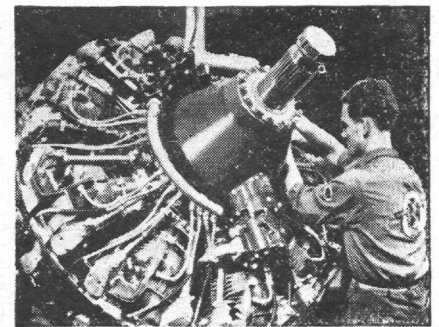
If you're like some twenty millions of your fellow Americans, you're getting set to fly as soon as you can after the war. How soon will this be? Where will you be able to go? What about comfort? And cost? Here's what an American airman who has flown all over the world can tell you:



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3. "And as for speed . . . well, when multi-engine transports can cross the country in six hours, you get some idea of the concentration of power in their Wright Cyclone engines — the same dependable engines that power the B-29 Superforts and the giant Martin Mars.



4. "Vacations in Mexico, in Rio, on the Mediterranean, by air, may seem fantastic right now. Yet 27 airlines are already planning to take you to the markets and the playgrounds of the world at a cost well within your reach . . ."

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it to create hydraulic pressure to drive the turrets. This consumes a great amount of current and is probably one of the most important uses.

The importance of the electrical instruments and the radio cannot be overlooked. In a ship like the B-17, with four engines, it would be a serious problem to have to run tubes and pipes and linkages from each engine to the cabin for instrument use. The electrical system instruments reduce each instrument line to a few wires which are more easily run to the cabin. This requires a small motor generator unit; the motor end is a d.-c. 30-volt motor, and the generator is a 40-volt a. c. required for the selsyns.

In distinction to the B-17, the B-24 accomplishes many of these aforementioned functions by use of hydraulic units. There has been a great controversy over the relative merits of each system. It is true that each have their advantages, but the greatest, I believe, lies in the beating electrical equipment will take in combat as compared to the sensitiveness of hydraulic to enemy fire. Perhaps the ever more widespread use of electrical equipment in the B-29 is an indication that it is taking precedence over its competitor, hydraulic. I do not mean to infer that hydraulic is on its way out but its use will be restricted to those places where it can do a job more efficiently and neater than can electricity.